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**(54) Tamper evident closure and tamper evident method**

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**US-A- 4 184 701**

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## Description

The present invention relates to flexible tamper-evident tapes wherein the evidence of tampering is either a transfer of a pattern to the tampered product, revelation of a pattern on the backing of the closure, or tearing of the closure and/or the product over a wide temperature range including temperatures on the order of -320°F (-195°C) where other so-called tamper-evident seals do not exhibit tampering when removed and replaced later.

Tamper proofing has been of concern throughout the ages in the financial and security sectors. However recently it has taken on new significance due to tampering with food, cosmetic and pharmaceutical products.

The following patents are illustrative of the prior art, yet are by no means intended as a complete survey of the prior art.

The earliest patent, U.S. Patent No. 2,845,728 issued to Huber, discloses a self-destroying label having pressure sensitive adhesive on one surface thereof. The principal object of this invention provided for a pressure sensitive label readily applicable to items of various kinds. Yet, when an attempt is made to remove such labels from the article, the label is damaged or disintegrates to a sufficient extent so that the condition of the label, if removed from one article and applied to another, readily and visibly will serve to indicate that the label has been tampered with. Essentially, the invention consists of weakening means comprising either interrupted rows of incisions or substantially continuous partial incisions.

U.S. Patent No. 3,383,121 discloses a self-adhesive copy label comprising a laminate construction consisting of a first layer such as a sheet of paper, a second pressure sensitive adhesive layer, preferentially adhered to the first layer so that it separates with the first layer when the first and third layers are separated, and a third layer consisting of a sheet of material constructed to be impact sensitive in that it carries, in normally separate states, chemicals which intermix upon impact to produce a color change in the impact area in or on the third layer itself. Thus the tamper evidence here is a color change.

U.S. Patent No. 4,082,873 issued to Williams discloses a "laminate comprising a transparent or translucent outer sheet having an information-containing pattern printed on its inner surface, the printed inner surface having a coating of pressure sensitive adhesive film coated thereon. The affinity of the adhesive for the surface to which the laminated label is adhered and to the printed pattern is greater than the affinity of the printed pattern for the outer sheet. Once applied to a substrate, if removal of the label is attempted, the label delaminates in a manner such that the outer sheet separates leaving at least a portion of the adhesive layer, having at least a portion of the printed Pattern adhering thereto, adhered to the substrate."

U.S. Patent No. 4,121,003 issued to Williams modifies Patent No. 4,082,873, by providing that at least a portion of the information-containing pattern be printed with an ink which is not dried into an integral film form so as to form a disruptable pattern when tampered with. Thus when the top sheet is delaminated from the adhesive, a portion of the pigmentation in the disruptable pattern adheres to both the top sheet as well as the adhesive layer, resulting in a "diminution of interruption of the coloration of the disruptable pattern on the top sheet sufficient to give visual indication of tampering."

U.S. Patent No. 4,184,701 issued to Franklin et al discloses a label comprising "a laminate comprising a transparent or translucent outer sheet having an information containing pattern printed on its inner surface, said printed film having a discontinuous coating of transparent plasticized organic polymeric material thereon, with said printed and coated surface having a coating of a color containing pressure sensitive adhesive film thereon." Upon removal the label delaminates such that at least portions of the colored adhesive in register with the transparent discontinuous plasticized polymer coating remain on the substrate to which the label is adhered. Thus the evidence of tampering is a visual change in at least portions of background color.

U.S. Patent No. 4,608,288 issued to Spindler discloses a label comprising a cover foil with an adhesive layer laminated onto a base foil. The cover foil is made of a material which is irreversibly deformable or easily breakable upon tampering. Moreover, the cover foil extends beyond the periphery of the base foil, thereby creating a safety rim which makes access to the base foil difficult.

U.S. Patent No. 4,652,473 issued to Han discloses a tape comprising a backing having an outer and inner layer, the outer layer having sufficiently high tensile strength to maintain its integrity when removed. In contrast, the inner layer is thin and deformable. Thus, evidence of tampering is present by way of delamination. Upon removal of the outer layer, it delaminates from the inner layer which in turn generally causes a partial stretching out of the thin inner layer. Moreover, the patentee suggests using printed or colored layers for additional evidence.

U.S. Patent No. 4,721,638, 4,746,556 and 4,763,931 all issued to Matsuguchi et al disclose a multilayered adhesive material comprising various separation forces so that when particular layers are separated they cannot readhere or cannot readhere as in the original state.

The primary disadvantage of the prior art, as illustrated by the aforementioned patents, is evident at low temperature. At low temperatures, such as liquid nitrogen for example, the adhesive layers delaminate from the backing, thereby allowing for replacement without any evidence of tampering. Notably, while this delamination does occur in

the three patents issued to Hatsuguchi et al, lettering becomes evident when the material is replaced. However, these tapes comprise multiple layers and thus are quite costly.

The present invention obviates the disadvantages of the prior art in an elegant and novel manner by providing for a tamper evident closure effective at a wide range of temperatures.

In accordance with this invention, the aforementioned disadvantages are obviated by providing a tamper-evident closure comprising a transparent backing layer and an adhesive layer for attaching the backing layer to a substrate characterised in that the transparent backing layer has surface adhesion properties which vary from location to location, a first adhesive layer, the adhesion of which to the backing layer varies from location to location from a first value to lower values and a second adhesive layer for attaching the first adhesive layer and the backing layer to a substrate, the first value of adhesion of the first adhesive layer to the backing being greater than the value of the adhesion of the second adhesive layer to the first adhesive layer, the arrangement being such that an attempted removal of the closure from a substrate will result in a visually detectable change in appearance, the closure providing evidence of tampering over a wide temperature range from above to below the T<sub>g</sub> (glass transition temperature) of the adhesive layer adhering the closure to the substrate to be protected.

The substrate may be a bag pouch.

The surface adhesion properties of the backing layer may be varied by chemical etching. Alternatively, the surface adhesion properties of the backing layer may be varied by depositing a barrier material having reduced adhesion properties such as a silicone, discontinuously on the backing layer.

The first adhesive layer is desirably of a different colour to the second adhesive layer. The second adhesive layer may contain an ingredient which gives a colour reaction with skin.

The backing layer may be of polyester, polyolefin, polycarbonate or a cellulosic ester or copolymers or blends thereof. The barrier material may be a silicone, a fluorocarbon, or polyoctadecyl carbonate as discrete deposits. The first adhesive layer may be a polyester adhesive. The second adhesive layer may be an acrylic pressure sensitive adhesive.

The backing layer is preferably 0.5 to 3 mils (0.013 to 0.075 mm) thick. The deposits of barrier material are preferably up to about 1 micron (micrometre) thick. The first adhesive layer is preferably 0.1 to 0.5 mil (0.0025 to 0.013 mm) thick. The second adhesive layer is preferably 0.1 to 0.4 mil (0.0025 to 0.01 mm) thick.

The invention may be put into practice in various ways and one specific embodiment will be described by way of example with reference to the accompanying drawing which is a diagrammatic cross-sectional view of the novel tamper-evident tape of this invention.

As heretofore mentioned, the present invention is directed to a novel tamper-evident tape for applying over the flap or other opening in pouches, bags, envelopes or other containers for currency, security documents and the like, which tape will exhibit evidence of tampering if the tape is removed to gain access to the contents and then replaced.

The invention will best be understood by reference to the accompanying drawings.

As shown therein, the novel tamper-evident closure of this invention 10 will comprise a transparent backing 12 carrying, in order, a discontinuous layer of a barrier material 14; a coloured laminating adhesive layer 16; and an adhesive layer 18, preferably a pressure-sensitive adhesive, which bonds aggressively to the bag, pouch, envelope or other substrate. While not essential to the practice of the invention, a per se known release sheet 20 is preferably provided to protect the adhesive surface from premature contact.

Backing layer 12 may comprise any of the per se known transparent and flexible backing or support sheets, e.g. a polyester such as polyethylene terephthalate, a polyolefin such as polyethylene or polypropylene, polycarbonate, a cellulosic ester such as cellulose acetate or triacetate, etc., including copolymers or blends thereof. It may be on the order of from about 0.5 to about 3.0 mils (0.013 mm to 0.075 mm) thick, 1.0 mil (0.025 mm) being preferred.

The barrier material 14, which is preferably applied in a pattern but which may be randomly adhered to the backing, may comprise any material which does bond aggressively to the backing 12. Examples of such materials include silicone, fluorocarbons, Quilon (trademark of DuPont), polyoctadecyl carbonate, etc., silicone being preferred. The function of the barrier material 14 is to preclude or reduce the adherence of the underlying coloured laminating adhesive layer 16 to the backing 12 in the areas where it is deposited. The barrier material 14 is preferably transparent or translucent so that the underlying coloured layer 16 may be seen therethrough when viewed through the transparent backing 12. The barrier material deposits may, for example, be on the order of about 1.0 micron (micrometre) thick. They may be provided on the inner surface of the backing 12 by per se known techniques such as gravure or flexible printing, spray coating, chemical etching and the like.

The laminating adhesive layer 16 has a greater affinity for the backing 12 than for the adhesive layer 18. Accordingly, when an effort is made to strip the tape from the substrate, the layer 16 tends to stay with the backing 12.

The layer 16, which contains a colour-providing material, e.g. a non-migrating dye or a pigment, may comprise any of the known laminating adhesives. For instance, if the backing 12 comprises polyester, the coloured layer 16 may comprise any of the commercially available polyester laminating adhesives in which the colour-providing material has been incorporated.

The thickness of the coloured layer 16 may be on the order of from about 0.1 to about 0.4 mil or 0.5 mil (.0025 to 0.01 mm or 0.013 mm), a preferred thickness being about 0.2 mil (0.0051 mm).

The adhesive layer 18 used to laminate the tape to the substrate, which is to be sealed, may comprise an acrylic pressure sensitive adhesive formulation which adheres aggressively to the substrate. To increase flow and adhesion to the substrate, the adhesive preferably includes an adhesion promoter such as an unsaturated higher fatty acid having at least 12 carbon atoms, oleic acid being illustrative. Tackifiers and/or plasticizers may also be incorporated in the acrylic adhesive to increase adhesion.

In any event, it is critical to the practice of this invention, as will be explained in detail hereinafter, that while the adhesive 18 must adhere aggressively to the substrate, the bond or affinity between the layer 18 and the overlying coloured layer 16 must not be as great as the affinity of the layer 16 to the backing 12.

In optional embodiments, the layer 18 may further contain a non-migratory colour-providing material contrasting with the colour-providing material in the overlying layer 16. It may also contain a chemical reagent which, through contact with the skin of someone trying to remove the tape, produces a traceable reaction product in the skin and/or on the layer 18 itself, or on the pouch with which it is used.

In use, the tape will of course be applied over the mouth or other opening in the container or other substrate to be sealed. When the tape is removed at a temperature above the Tg value of the layer 18, e.g. at ambient temperatures, so as to tamper with the contents, in areas where no barrier material is present, the coloured layer 16 will remain with the backing, as heretofore alluded to. However, in areas where the barrier material 14 is present so as to preclude adhesion of the coloured layer 16 to the backing, the coloured layer will be stripped away from the barrier, adhering to the adhesive layer 18 which remains aggressively bonded to the substrate. This will in turn provide a coloured pattern on the substrate in terms of adhered colourant from the layer 16 and a reverse contrast image visible through the stripped-off backing in terms of the remaining coloured layer and areas where there is no colourant visible through the backing. Even when an attempt is made to re-apply the tape precisely to the substrate, evidence of its removal will still be readily visible to the eye, due to distortion of the adhesive.

When the tape is removed at a temperature below the Tg value of the adhesive, e.g. by first spraying with liquid nitrogen, and then removing the tape, visual evidence of the tampering will also be exhibited in one or more of the following ways.

First, when the tape is removed from the substrate, the adhesive layer 18 will delaminate from the coloured layer 16 except where barrier layer 14 is present. At these areas, the coloured layer 16 will break from the barrier layer 14 and transfer with the adhesive layer 18.

A second possible evidence of tampering, is that the backing is liable to tear, leaving an image on the substrate along with the evidence of tearing of the backing.

A third evidence which may occur is a noticeable wrinkling or distortion of the substrate.

The invention also extends to a tamper evident method for securing a bag pouch from tampering comprising the steps of:

- (a) attaching a closure in accordance with the invention along either side of the opening of the said pouch,
- (b) closing the said pouch by bringing both sides in juxtaposition and adhering one side to the other by means of the said closure.

The invention also extends to a bag pouch comprising a tamper evident closure in accordance with the present invention.

The following examples show by way of illustration and not limitation the novel characteristics of the present invention.

EXAMPLE 1

Layer	Ingredient	Thickness
Layer 1	Mylar* (polyester film)	1 mil (0.025 mm)
Layer 2	Silicone	<1 u (micron) (micrometre)
Layer 3	Polyester Laminating Adhesive	0.4-0.5 mil) (0.01 to 0.013 mm)
Layer 4	10% Blue Pigment Ethylacetate Based Acrylic Adhesive	0.1-0.4 mil (0.0025 to 0.01 mm)
Layer 5	5% Oleic Acid Kraft Release Liner	4 mils (0.10 mm)

\* Trademark of DuPont

**EXAMPLE 2**

Mylar film was flexible printed with a silicone layer. The printed side was then overcoated with the laminating layer which was in turn overcoated with the adhesive layer. Lastly, a Kraft release liner was applied to the adhesive side of the aforementioned film.

In each of Examples 1 and 2 the silicone layer was discontinuous as shown diagrammatically in the drawing.

By way of recapitulation, the present invention offers a tamper evident closure over a temperature ranging from +150°F to -320°F (+66°C to -195°C). Among the many tamper evident mechanisms are: transfer of a coloured pattern to the substrate, revealing of a printed pattern on the backing, tearing of the backing, colour change, wrinkling of the substrate, finger prints as well as transfer of colour to the person doing the tampering.

**Claims**

1. A closure (10) comprising a transparent backing layer and an adhesive layer for attaching the backing layer to a substrate, the transparent backing layer (12) has surface adhesion properties which vary from location to location, characterised by a first adhesive layer (16), the adhesion of which to the backing layer (12) varies from location to location from a first value to lower values and a second adhesive layer (18) for attaching the first adhesive layer (16) and the backing layer (12) to a substrate, the first value of adhesion of the first adhesive layer (16) to the backing (12) being greater than the value of the adhesion of the second adhesive layer (18) to the first adhesive layer (16), the arrangement being such that an attempted removal of the closure from a substrate will result in a visually detectable change in appearance, the closure providing evidence of tampering over a wide temperature range from above to below the Tg (glass transition temperature) of the adhesive layer adhering the closure to the substrate to be protected.
2. A closure as claimed in claim 1 characterised in that the surface adhesion properties of the backing layer (12) are varied by chemical etching.
3. A closure as claimed in claim 1 characterised in that the surface adhesion properties of the backing layer are varied by depositing a barrier material (14) having reduced adhesion properties discontinuously on the backing layer (12).
4. A closure as claimed in claim 3 characterised in that the material is a silicone.
5. A closure as claimed in any one of claims 1 to 4 characterised in that the first adhesive layer (16) is of a different colour to the second adhesive layer (18).
6. A closure as claimed in any one of claims 1 to 5 characterised in that the second adhesive layer (18) contains an ingredient which gives a colour reaction with skin.
7. A closure as claimed in any one of claims 1 to 6 characterised in that the backing layer (12) is of polyester, polyolefin, polycarbonate or a cellulosic ester or copolymers or blends thereof, the barrier material (14) is a silicone, a fluorocarbon, or polyoctadecyl carbonate as discrete deposits, the first adhesive layer (16) is a polyester adhesive and the second adhesive layer (18) is an acrylic pressure sensitive adhesive.
8. A closure as claimed in any one of claims 1 to 7 characterised in that the backing layer (12) is 0.5 to 3 mils (0.013 to 0.075 mm) thick, the deposits of barrier material (14) are up to about 1 micron (micrometre) thick, the first adhesive layer (16) is 0.1 to 0.5 mil (0.0025 to 0.013 mm) thick and the second adhesive layer (18) is 0.1 to 0.4 mil (0.0025 to 0.01 mm) thick.
9. A tamper evident method for securing a bag pouch characterised in that it comprises the steps of:
  - (a) attaching a closure in accordance with any one of claims 1 to 8 along either side of the opening of the said pouch,
  - (b) closing the said pouch by bringing both sides in juxtaposition and adhering one side to the other by means of the said closure.

## Patentansprüche

1. Verschuß (10) mit einer transparenten Unterlagsschicht und einer Klebeschicht zum Anbringen der Unterlagsschicht an einem Substrat, wobei die transparente Unterlagsschicht (12) Oberflächeneigenschaften hat, die von Ort zu Ort variieren, gekennzeichnet durch eine erste Klebeschicht (16), deren Haftvermögen zu der Unterlagsschicht (12) von Ort zu Ort von einem ersten Wert zu niedrigeren Werten variiert, und eine zweite Klebeschicht (18) zum Anbringen der ersten Klebeschicht (16) und der Unterlagsschicht (12) an einem Substrat, wobei der erste Wert des Haftvermögens der ersten Klebeschicht (16) an der Unterlagsschicht (12) größer ist als der Wert des Haftvermögens der zweiten Klebeschicht (18) an der ersten Klebeschicht (16), wobei die Anordnung derart ist, daß eine versuchte Entfernung des Verschlusses von einem Substrat zu einer sichtbar erfaßbaren Veränderung im Aussehen führt, wobei der Verschuß Beweis für Eingriffe über einen weiten Temperaturbereich von oberhalb bis unterhalb von Tg (Glasübergangstemperatur) der Klebeschicht, die den Verschuß an das zu schützende Substrat klebt, bereitstellt.
2. Verschuß nach Anspruch 1, dadurch gekennzeichnet, daß die Oberflächeneigenschaften der Unterlagsschicht (12) durch chemisches Ätzen variiert sind.
3. Verschuß nach Anspruch 1, dadurch gekennzeichnet, daß die Oberflächeneigenschaften der Unterlagsschicht durch diskontinuierliches Aufbringen eines Barrierenmaterials (14) mit reduzierten Hafteigenschaften auf die Unterlagsschicht (12) variiert sind.
4. Verschuß nach Anspruch 3, dadurch gekennzeichnet, daß das Material ein Silikon ist.
5. Verschuß nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die erste Klebeschicht (16) eine andere Farbe hat als die zweite Klebeschicht (18).
6. Verschuß nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die zweite Klebeschicht (18) einen Bestandteil enthält, der eine Farbreaktion mit Haut ergibt.
7. Verschuß nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß die Unterlagsschicht (12) aus Polyester, Polyolefin, Polycarbonat oder einem Celluloseester oder Copolymeren oder Mischungen daraus besteht, das Barrierenmaterial (14) ein Silikon, ein Fluorcarbon oder Polyoctadecylcarbonat als diskrete Ablagerungen ist, die erste Klebeschicht (16) ein Polyesterkleber ist und die zweite Klebeschicht (18) ein druckempfindlicher Acrylkleber ist.
8. Verschuß nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß die Unterlagsschicht (12) 0,5 bis 3 mils (0,013 bis 0,075 mm) dick ist, die Ablagerungen von Barrierenmaterials (14) bis zu etwa 1 Mikron (Mikrometer) dick sind, die erste Klebeschicht (16) 0,1 bis 0,5 mil (0,0025 bis 0,013 mm) dick ist und die zweite Klebeschicht (18) 0,1 bis 0,4 mil (0,0025 bis 0,01 mm) dick ist.
9. Sicherheitsverfahren zum Sichern eines Beutels, dadurch gekennzeichnet, daß es die Schritte aufweist:
  - (a) Anbringen eines Verschlusses gemäß einem der Ansprüche 1 bis 8 entlang einer Seite der Öffnung des Beutels,
  - (b) Schließen des Beutels, indem beide Seiten in Nebeneinanderstellung gebracht werden und eine Seite an die andere mittels des Verschlusses geklebt wird.

## Revendications

1. Fermeture (10), comprenant une couche de renfort arrière transparente et une couche adhésive pour fixer la couche de renfort arrière transparente sur un support, dans laquelle la couche de renfort arrière transparente (12) présente des propriétés d'adhérence de surface qui varient d'un endroit à l'autre, caractérisée par une première couche adhésive (16) dont l'adhérence avec la couche de renfort arrière (12) varie d'un endroit à l'autre entre une première valeur et des valeurs inférieures, et une seconde couche adhésive (18) pour fixer la première couche adhésive (16) et la couche de renfort arrière (12) sur un support, la première valeur d'adhérence de la première couche adhésive (16) au renfort arrière (12) étant supérieure à la valeur d'adhérence de la seconde couche adhésive (18) à la première couche adhésive (16), l'agencement étant tel que, lorsqu'on tente d'enlever la fermeture

d'un support, cela entraîne un changement d'aspect détectable visuellement, la fermeture fournissant une preuve de tentative d'effraction dans une large plage de températures allant d'une température supérieure à la Tg (température de transition vitreuse) à une température inférieure à la Tg de la couche adhésive fixant la fermeture sur le support qui doit être protégé.

2. Fermeture selon la revendication 1, caractérisée en ce que les propriétés d'adhérence de surface de la couche de renfort arrière (12) sont modifiées par attaque chimique.
3. Fermeture selon la revendication 1, caractérisée en ce que les propriétés d'adhérence de surface de la couche de renfort arrière sont modifiées en déposant de manière discontinue un matériau de barrière (14) présentant des propriétés d'adhérence réduites sur la couche de renfort arrière (12).
4. Fermeture selon la revendication 3, caractérisée en ce que le matériau est un silicone.
5. Fermeture selon l'une quelconque des revendications 1 à 4, caractérisée en ce que la première couche adhésive (16) est d'une couleur différente de celle de la seconde couche adhésive (18).
6. Fermeture selon l'une quelconque des revendications 1 à 5, caractérisée en ce que la seconde couche adhésive (18) contient un ingrédient qui donne une réaction de coloration avec la peau.
7. Fermeture selon l'une quelconque des revendications 1 à 6, caractérisée en ce que la couche de renfort arrière (12) est réalisée en polyester, en polyoléfine, en polycarbonate ou en ester de cellulose, ou en copolymères ou en mélanges de ceux-ci, le matériau de barrière (14) est un silicone, un hydrocarbure fluoré ou un carbonate de polyoctadécyle présentant la forme de dépôts discontinus, la première couche adhésive (16) est un polyester adhésif et la seconde couche adhésive (18) est un adhésif acrylique sensible à la pression.
8. Fermeture selon l'une quelconque des revendications 1 à 7, caractérisée en ce que la couche de renfort arrière (12) est d'une épaisseur de 0,013 à 0,075 mm (0,5 à 3 mils), les dépôts du matériau de barrière (14) ont jusqu'à 1 micromètre d'épaisseur, la première couche adhésive (16) est d'une épaisseur de 0,0025 à 0,013 mm (0,1 à 0,5 mil) et la seconde couche adhésive (18) est d'une épaisseur de 0,0025 à 0,01 mm (0,1 à 0,4 mil).
9. Procédé de mise en évidence de tentatives d'effraction en vue de protéger un sac, caractérisé en ce qu'il comprend les étapes consistant à :
  - (a) fixer une fermeture selon l'une quelconque des revendications 1 à 8, sur un quelconque des côtés de l'ouverture dudit sac,
  - (b) fermer ledit sac en superposant les deux côtés et en fixant un côté à l'autre au moyen de ladite fermeture.

